July 26, 2002

To: Federal Communications Commission
From: IEEE/Power System Relaying Committee

In the matter of NPRM FCC 02-136, ET Docket No. 02-98:
Proceeding to allocate new frequency bands to the Amateur Radio Service:

The IEEE/Power System Relaying Committee (IEEE/PSRC) remains concerned that interference resulting from the proposed licensed use of the 135.7 - 137.8 kHz band by the Amateur Radio Service will impact the reliability of electrical service in the United States. The only way to assure that the power system reliability remains consistent with past experience is to disapprove any allocation in the PLC band. The citizens of the United States enjoy and rely on reliable power. The Federal Government should take all actions necessary to maintain this reliability.

None of the ECFS comments discuss the methods that the amateur community will use to minimize interference. Without knowledge of the interference potential, coupled with the inability to detect interference situations, there is little that an amateur can do to reduce the risk of disrupting proper power system communications. Additionally, none of the comments address any benefit that the Amateur Radio Service will provide to the public if a LF allocation should be granted. While an allocation in the LF band would allow experimentation, the resultant technology will not benefit the immediate needs of the public. The needs of the public are best met by maintaining reliable electrical power rather than a LF allocation. Review of the same comments show clear benefits to the public should a 5 MHz band allocation be granted.

The 125 to 140 kHz Band, referred to as the "C-Band", is allocated for Consumer Use in Europe. Primarily the C-Band is used for automation applications operating over power distribution circuits CENELEC EN-50065-1 is referred to by several manufacturers who make compliant products. Equipment in this band use protocols such as spread spectrum and packet which improve reliability and would offer a high level of interference tolerance from amateur operations. It is important to understand the frequencies that electric utilities use for power system protection and their relationship to potential interference from amateurs. Hence claims of prior experience between amateur radio operations and utility PLC need to be further evaluated.

If the FCC feels that there is value with experimentation in this band, the use of experimental licenses should be explored. These licenses can be coordinated geographically with the electric utilities via the UTC database. The FCC could assure that the transmitter and antenna meets established requirements through the licensing process.

Comments:

The following comments on NPRM FCC 02-98 pertain to the sections relevant to the LF allocation only. The PSRC subcommittee of the IEEE is concerned with utility power system protection only, hence, the section of the NPRM relating to the 5250 - 5400 kHz and 2400-2402 MHz bands are not within its scope and will not be discussed.

The FCC clearly respects the potential interference risk. Requirements in the NPRM for amateur licensing in the 135.7 - 137.8 kHz band indicating the power level, antenna EIRP, and bandwidth will minimize the risk of interference. The comments provided here will attempt to further minimize the risk and offer, where appropriate, opportunities for changing the proposal to minimize the potential loss of power to utility customers should the FCC choose to permit operation as proposed. However, the IEEE/PSRC maintains it position opposing the LF allocation recommended in 02-98.

Frequency Allocation:

The IEEE/PSRC agrees that allowing amateur licensed use of the 135.7 to 137.8 kHz band only, will reduce the risk of interference dramatically compared to the original ARRL proposal. While the UTC data base indicates 430 PLC systems in this band, the density in the 160 to 190 kHz band is much higher. Allowing the 160 to 190 bands power and antenna requirements to remain as they are in Part 15 will satisfy the current non-licensed experimenters in this band. The interference risk to utilities operating in this band will not be increased. We agree with the FCC decision to not provide an Amateur allocation in the 160 to 190 kHz band.

Power, Antenna and EIRP:

With respect to proposed restrictions on amateur licensed operations in the 135.7 - 137.8 band, clearly a transmitter maximum power output allowance of 100 watts compared to the ARRL proposal of 200 watts will reduce the EIRP for a given antenna design and configuration. However, the difficulty in measuring the EIRP will still exist. The terms "typical operator" and "the typical antenna" have been used to categorize the type of antenna that will be used as one of minimal efficiency. IEEE/PSRC believes that the amateur community has the desire and wherewithal to use antennas of higher efficiency than the ARRL claims. This belief is justified based on the experimental results in other countries. An amateur operator (such as an employee of a utility) with the ability to use an actual out of service power line as an antenna, would not be excluded from doing so. The NPRM does not limit the antenna design or size. This situation could provide an antenna of over 100 miles long. With the expected variability in antenna design, assuring that the EIRP is less than 1 watt will be difficult. There have been announcements on the "low frequency" club web sites and comments to 02-98 that 1 watt EIRP levels are attainable. The DX spotting web site has shown amateurs using antennas as long at 360 meters. (http://oh2aq.kolumbus.com/dxs/137.html).

While EIRP is valuable in classifying the energy that an antenna radiates, it is of more concern to the utilities' protection engineers how much energy will be coupled into a transmission line. An antenna parallel to a transmission line will couple more energy, thus interference, into the transmission line than an antenna which is tangent. The IEEE/PSRC recommends, in conjunction with the transmitter and EIRP requirements, that the transmitter antenna length be restricted to less then 1/4 wavelength, or 1650 ft, on any given surface. Receive antennas would not be restricted. The restriction of antenna size will still allow the design experimentation while minimizing the coupling of energy into PLC systems.

The IEEE/PSRC recommends that a standard methodology be developed for determining the efficiency of a given antenna design either through measurement or calculation. As the 135.7 - 137.8 band will be a new to licensed amateur use, with most antennas being custom built, this methodology will provide the necessary guidance to allow the amateur to easily determine and operate within the EIRP requirements. This information should be provided in the LF handbook that the ARRL described. Measurements and calculations would need to be made at various locations based on the antenna's physical attributes to determine the radiation pattern (lobes), to assure that data is not only being collected at a minimum or maximum. The FCC or ARRL could provide antenna modeling software that could serve this purpose also.

Interference:

The proposal provides access to the LF allocation to licensees who have demonstrated knowledge by achieving the level of General Class. The ARRL recommended this when there were 6 license classes with none of them covering LF operation on the exam. Currently there are 3 license classes. A greater level of competency, such as the ability to determine the EIRP of an antenna, should be relegated to the Amateur Extra classification until actual field experience is gained. Additionally, there should be exam questions related to LF operation, rules and antenna design challenges. We agree that the higher the class of license the more technically educated the operator. This knowledge will help to minimize interference. However as existing license holders do not require re-testing there is no assurance that an amateur will understand

what it takes to comply or demonstrate knowledge of PLC. Providing an experimental license path would assure an understanding of the rules.

At paragraph 23 of the NPRM, the Commission postulates that "interference would be rare because amateur radio operators have apparently demonstrated their effective use of the "listen-before-transmit: protocol…". At paragraph 17, however, the Commission notes the IEEE/PSRC's prior comments that this technique will not be practical. On/Off communication is normally off. Frequency shift communication is not normally transmitting on the same frequency that it is looking for a "trip" signal on. Thus, the IEEE/PSRC must re-iterate that the conscientious amateur will not be able to use the "listen before transmit" protocol to minimize the risk of interference.

In determining the number of current users of the spectrum between 135.7 and 137.8 kHz consideration was given to the "transmitter center" frequencies of the PLC users. The UTC database indicated that there were 430 PLC systems in operation in 400 locations in the 135.7 - 137.8 band. The IEEE Guide for Power Line Carrier (Standard 643-1980, Table 19 section 6.2.2) requires 4 kHz separation from sources of interference. These sources can be other carrier systems or coupled signals. This makes the potential interference band 131.7 to 141.8 kHz, increasing the number of installed systems that would be affected by amateur operations in the band in question. Consultation with the UTC indicated that the 2001 database showed 2000 systems are in this band.

It is important to note that forward error correction, FEC, is not available for PLC used for power system protection systems. Noise detection is available on some equipment. These detectors affect the reliability of the PLC systems, however they are designed to operate for noise that the power system generates during electrical faults, not externally coupled noise. The utility protection engineer can predict these power system noise levels during system design and account for them in a way that cannot be done for noise from an external source. PLC systems will operate correctly even with the signal carrying conductor being faulted.

UTC: database

The UTC, United Telecom Council, maintains a database of PLC locations pursuant to 47 CFR 90.63. The information includes frequency, power, and location of transmitter(s), location of receiver(s). The frequencies provided are the "center" frequencies between the "mark" and "space" in the case of FSK equipment. The FSK shift can vary among applications. However this data is more than adequate to provide frequency coordination among utility users. An amateur would not be able to use this data to reduce the risk of interference.

The coupling levels will be associated with the physical proximity of the amateur to the to the power line. If the Amateurs antenna is largely parallel to the power line, then the coupling factor will be improved. The UTC data base does not indicate where the lines are. For security reasons, it would not be desirable for a utility to release information on the power system connections.

Because this proposal does not indicate that an Amateur would be restricted from operating in proximity to a power line having PLC in the 135.7 to 137.8 band, the UTC database information will not be useful. Additionally, making the UTC information public may facilitate misuse.

The IEEE/PSRC recommends that the information in the UTC database remains private and continue to be used by the FCC and utilities for frequency coordination purposes only.

Summary:

Utilities have used the PLC spectrum in conjunction with other users under the current part 15 rules. Equipment, systems, settings, and applications have been designed to provide reliable protection for the nation's electric power system. The use of PLC has been so effective that it is the first choice for many utilities and certainly one of the most cost effective. While manufacturers have improved their designs

with digital signal processing and remote diagnostics, the primary technology has remained unchanged. PLC equipment, old or new, is totally compatible with the most modern protection systems. The only way to assure the current state of power system reliability is to deny use of the low frequencies to the amateur radio license holders.

Based on the comments filed, there is little interest in the Low Frequency allocation. There is little mention or concern that this frequency band is used in the United States to maintain the reliability of the power system. The small quantify of interested users could be Amateur radio license holders that are given experimental licenses for clearly defined geographic locations and antenna's. Utilities understand that they may be the benefactors of new technologies, however they are not willing to risk power interruption.

Should interference cause power system outages, amateurs, utilities as well as the FCC will need to be concerned over liability issues. Has the FCC consulted with other agencies such as FERC or NRC. Utilities are also concerned on what actions they would be required to take if they should cause interference to an Amateur. Would power lines have to be shut down because the PLC must be shut off? Would a Nuclear station have to cease operation. Would there be fines? It can take close to 6 months to engineer and acquire equipment to make frequency changes at a cost of up to $100,000 per line end. There are approximately 400 power system stations currently transmitting with very long "antennas". The stations use anywhere between 1 and 100 watts. There will be amateurs that will detect the steady signal of PLC transmitters on a daily basis. Will they claim interference?

If the FCC chooses to provide a low frequency allocation for the amateur radio service, the recommendations in this document will reduce the risk of interference and it's effects to the power system. However, even following these recommendations may not be enough to maintain the current level of reliability that the PLC systems have provided since amateur use of the band would naturally increase the risk of conflict with utilities' power system protection systems operating in the same band.

Respectfully Submitted,

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